(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 632 522 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94110099.2**

(51) Int. Cl.[6]: **H01Q 1/42**, H01Q 15/08

(22) Date of filing: **29.06.94**

(30) Priority: **30.06.93 JP 161006/93**

(43) Date of publication of application:
04.01.95 Bulletin 95/01

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **MURATA MANUFACTURING CO., LTD.**
26-10, Tenjin 2-chome
Nagaokakyo-shi,
Kyoto 617 (JP)

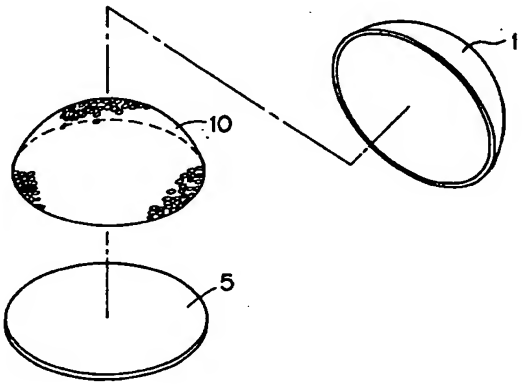
(72) Inventor: **Yamamoto, Keizo, c/o Murata Manufacturing Co., Ltd**
26-10, 2-chome, Tenjin
Nagaokakyo-shi,
Kyoto 617 (JP)

(74) Representative: **Schoppe, Fritz, Dipl.-Ing.**
Patentanwalt,
Georg-Kalb-Strasse 9
D-82049 Pullach (DE)

(54) Dielectric lens for an antenna and manufacturing process thereof.

(57) A dielectric lens which consists of a radome (1) which is a dome shell, a lid (5), and a foamy body (10) produced by fusion-molding of preexpanded beads. The foamy body is mounted in the radome, and the radome is closed with the lid.

F I G. 1.



EP 0 632 522 A1

[Technical Field]

The present invention relates to a dielectric lens, and more particularly to a dielectric lens used as an element of an antenna for receiving microwave for communication and broadcasting.

[Background Art]

A dielectric lens used as an element of an antenna for receiving microwave of 5GHz or more is conventionally produced by: mixing a resin, for example, polypropylene, polyethylene, polystyrene or the like, with ceramic powder, which acts as a foaming agent and as a dielectric constant conditioner; and molding the mixture into a dome. In the molding, the surface of the dielectric lens is solidified, and a radome layer is formed. The radome layer protects the inner foamy body from weathering and reinforces the foamy body.

In the conventional manufacturing process, the dielectric lens is molded to be thick and accordingly to be heavy. For example, if a mixture of polypropylene and ceramic powder is molded into a dome which is about 180mm in diameter and about 76mm in height, the weight will be about 1kg. Thus, a large quantity of resin is necessary, and the cost of the dielectric lens is high.

The thickly molded dielectric lens is likely to have a defect such as a sink mark and a swirl mark on the surface (radome layer) and a void inside. The defect can be fairly avoided by adopting injection compression molding. However, the injection compression molding requires a mold of a complicated structure and expensive facilities. Even in the injection compression molding, it is difficult to completely prevent occurrence of a sink mark, a swirl mark and a void. Further, a product by the injection compression molding has residual stress, which is a cause of deflection.

[Disclosure of the Invention]

An object of the present invention is to provide a light and inexpensive dielectric lens which does not have a defect such as a sink mark, a swirl mark and a void.

Another object of the present invention is to provide a simple manufacturing process of a dielectric lens which does not require expensive facilities.

In order to attain the above objects, a dielectric lens according to the present invention comprises a radome which is molded as a dome shell of a specified size, and a foamy body with a specified dielectric constant which is mounted in the radome.

The foamy body consists essentially of preexpanded beads. A specified quantity of preexpanded beads are deposited in the radome, and the radome is closed with a lid. Alternatively, the preexpanded beads are deposited in a mold and are fusion-molded into a body which has a curved surface identical with the inner surface of the radome. Then, the fusion-molded body is mounted in the radome, and the radome is closed with a lid.

According to the present invention, the radome and the foamy body are molded separately, and the produced lens is less likely to have a sink mark, a swirl mark and/or a void compared with a conventional dielectric lens produced by integral molding. Also, since preexpanded beads are used for the foamy body, only a small quantity of resin is necessary, thereby lessening the weight. The radome is formed by ordinary thinwall injection molding, and the foamy body is formed by ordinary foaming. Therefore, such expensive facilities as to be used for injection compression molding are not required, and the cost for facilities is low.

[Brief Description of the Drawings]

These and other objects and features of the present invention will be apparent from the following description in connection with the accompanying drawings, in which:

Fig. 1 is an explosive perspective view of a dielectric lens which is an embodiment of the present invention; and

Fig. 2 is a sectional view of the assembled dielectric lens.

[Best Mode for Carrying out the Invention]

A dielectric lens according to the present invention and a manufacturing process thereof are hereinafter described with reference to the accompanying drawings.

In Figs. 1 and 2, numeral 1 denotes a radome, numeral 5 denotes a lid, and numeral 10 denotes a foamy body. The radome 1 is molded as a dome shell of a specified size. The foamy body 10 has a curved surface which is identical with the inner surface of the radome 1 such that the foamy body 10 will be mounted in the radome 1 with no space in-between.

The foamy body 10 is produced by the following process. In a water disperse system in an autoclave, an aliphatic hydrocarbon, for example, hexane, butane, pentane or the like, is impregnated into polymer particles of polystyrene. Further, a dielectric constant conditioner is added, and the polystyrene is preexpanded. By the preexpansion, polystyrene preexpanded beads are obtained. Next, the preexpanded beads are deposited in a mold and are fusion-molded. The inner surface of the mold is identical with the inner surface of the

radome 1 such that the fusion-molded body 10 can be mounted in the radome 1 with no space in-between.

The radome 1 and the lid 5 are made thin, out of the same polystyrene used for the foamy body 10 by a conventional method such as injection molding.

The foamy body 10 is mounted in the radome 1, and the lid 5 is set at the opening of the radome 1. Thus, a dielectric lens is assembled. The radome 1 and the lid 5 are preferably bonded airtight by an adhesive or by ultrasonic welding. The radome 1 is desirably thin for a high antenna gain and is made to be 2mm, and more desirably 1mm or less, in thickness. In point of the antenna gain, it is further preferred that the space between the radome 1 and the foamy body 10 is not more than 0.5mm. If a pigment such as titanium oxide is added to the material of the radome 1, the radome 1 will absorb ultraviolet rays, which helps the foamy body 10 maintain its characteristic and lengthens the life of the lens.

The followings are exemplary constituents of the foamy body 10.

resin: polystyrene at a mixing ratio by weight of 100

dielectric constant conditioner: calcium titanate at a mixing ratio by weight of 60

foaming agent: butane

The dielectric constant conditioner and the foaming agent were added to the resin, and the resin was preexpanded at an expansion ratio of 15. Then, the preexpanded resin was fusion-molded. As a result, a foamy body 10 which has a dielectric constant of 1.5 and has a weight of 250g was produced.

It is possible to eliminate the fusion-molding process. The preexpanded beads are deposited directly in the radome 1, and the radome 1 is closed with the lid 5.

The constituents of the materials of the radome 1, the lid 5 and the foamy body 10 are not limited to those described above. As the resin, polystyrene, polypropylene, polyethylene, etc. can be used. As the foaming agent, butane, pentane, etc. can be used. As the dielectric constant conditioner, calcium titanate, barium titanate, etc. can be used.

Although the present invention has been described in connection with the preferred embodiment, it is to be noted that various changes and modifications are possible to those who are skilled in the art. Such changes and modifications are to be understood as being within the scope of the present invention.

Claims

1. A dielectric lens for an antenna, comprising:
   a radome which is a dome shell of a specified size; and
   an expanded material which is deposited in the radome, the expanded material having a specified dielectric constant.

2. A dielectric lens for an antenna as claimed in claim 1, wherein the expanded material is shaped into a dome whose curved surface is substantially identical with an inner surface of the radome.

3. A dielectric lens for an antenna as claimed in claim 1, wherein the expanded material is preexpanded beads.

4. A dielectric lens for an antenna as claimed in claim 1, wherein the radome contains a ultraviolet-ray absorbing agent.

5. A method for producing a dielectric lens for an antenna, the method comprising the steps of:
   molding a radome as a dome shell of a specified size;
   forming preexpanded beads with a specified dielectric constant;
   fusion-molding the preexpanded beads into a dome whose curved surface is substantially identical with an inner surface of the radome; and
   mounting the fusion-molded dome in the radome and setting a lid at an opening of the radome.

6. A method for producing a dielectric lens for an antenna, the method comprising the steps of:
   molding a radome as a dome shell of a specified size;
   forming preexpanded beads with a specified dielectric constant; and
   depositing a specified quantity of the preexpanded beads in the radome and setting a lid at an opening of the radome.

FIG. 1

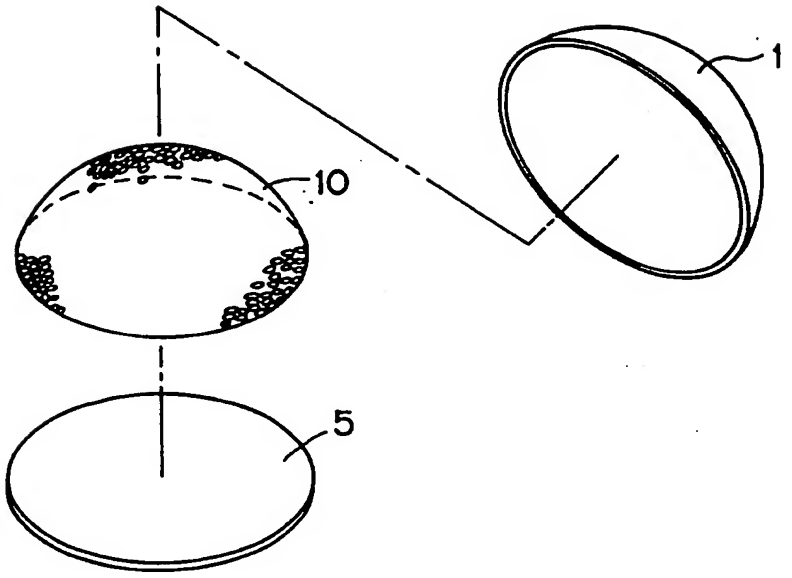
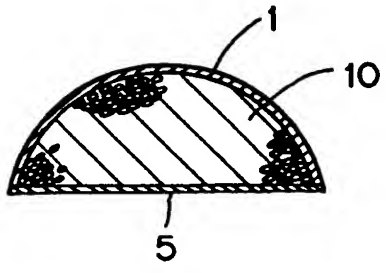


FIG. 2



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 0099

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	US-A-4 640 280 (STERZER) * abstract; figure 4 * * column 6, line 43 - line 47 * * column 11, line 58 - column 12, line 1 *	1	H01Q1/42 H01Q15/08
Y	US-A-4 288 337 (OTA ET AL.) * abstract; figure 3 * * column 2, line 48 - line 53 *	1	
A	WO-A-93 10572 (THOMSON CONSUMER ELECTRONICS S.A.) * abstract; figure 3 * * page 2, line 10 - page 3, line 15 * * page 5, line 30 - page 6, line 9 *	1-3	
A	US-A-4 482 513 (AULETTI) * the whole document *		
A	WO-A-89 08932 (THE SECRETARY OF STATE FOR DEFENCE, U.K.) * the whole document *		TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	US-A-3 917 773 (GATES,JR. ET AL.) * the whole document *		H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	7 October 1994	Danielidis, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)